A marginal cure-rate proportional hazards model for spatial survival data

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Dental studies often produce spatially-referenced multivariate time-to-event data, such as the time until tooth loss due to periodontal disease. These data are used to identify risk factors associated with tooth loss, and to predict outcomes for an individual patient. The rate ofspatial referencing can vary with various tooth locations. In addition, these event time data are heavily censored, mostly due to the fact that a certain proportion of teeth in the population are not expected to experience failure, and can be considered 'cured'. In this talk, we assume a proportional hazards (PH) model with a surviving fraction to model this clustered correlated data, and account for dependence between nearby teeth using spatial frailties which are modeled as linear combinations of positive stable random effects. This model permits predictions (conditioned on spatial frailties) that account for the survival status of nearby teeth, and simultaneously preserves the PH relationship marginally over the random effects for the susceptible teeth, allowing for interpretable estimates of the effects of risk factors on tooth loss. We explore the potential of this model via. simulation studies and application to a real dataset obtained from a private periodontal practice, and illustrate its advantages over other competing models to identify important risk factors for tooth loss and predict the remaining lifespan of a patient's teeth.

Keywords: Cure rate; Extreme value analysis; Positive stable; Tooth loss.